

Roadside Safety News

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Newsletter to Provide Roadside Safety Information

To update key Caltrans staff on roadside safety issues, the Engineering Service Center's Roadside Safety Technology Branch, in cooperation with the Traffic Operations Program, will begin producing this newsletter on a regular basis. The newsletter will provide updates on roadside safety features that have been approved or recommended for approval, as well as information on the development of features that have recently been crash tested by the Department or soon will be tested.

Hardware Must Meet Federal Requirements

The National Cooperative Highway Research Program (NCHRP), which is administered by the Transportation Research Board, published a report in 1993 entitled *Recommended Procedures for the Safety Performance Evaluation of Highway Features*. This document,

generally referred to as NCHRP Report 350, consists of detailed procedures for crash testing roadside safety hardware such as longitudinal barriers, crash cushions, terminals, sign and lighting supports and other devices. The report also specifies the types of data to be collected, methods for collecting it, and criteria for evaluating it. The Federal Highway Administration (FHWA) has determined that all roadside safety hardware used on the National Highway System must meet NCHRP Report 350 crash testing criteria. Working in cooperation with AASHTO, FHWA established implementation dates for various types of hardware. New installations of the specified hardware types cannot occur after the implementation dates unless FHWA has determined that the hardware meets NCHRP Report 350 criteria. Some of the key implementation dates are as follows:

October 1, 1998 - longitudinal barriers, terminals, crash cushions, truck-mounted attenuators and breakaway supports.

October 1, 2002 - work zone barriers (K-rail), guardrail to bridge rail transitions.

Although FHWA requires hardware compliance with NCHRP Report 350

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Hardware Must Meet Federal Requirements

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only on the National Highway System, it is Caltrans policy that all new roadside safety hardware installed on the state highway system must meet the FHWA requirements. This policy minimizes liability, provides for safer highways and ensures consistency in roadside safety practices.

Committee Reviews New Roadside Safety Products

The Caltrans Highway Safety Features New Products Committee (HSFNPC) is responsible for reviewing and assessing new roadside safety products. The committee is comprised of

representatives from a broad range of programs and disciplines, including Traffic Operations, Research, Structures, Maintenance, Construction, Design and Local Programs, Materials Engineering and Testing Services (METS) and the Districts. This helps ensure that new products meet the needs of the Department as a whole.

Vendors and manufacturers seeking Departmental approval of their roadside safety products regularly submit information on these products to Caltrans. The Caltrans New Product Coordinator forwards this information to the HSFNPC for a needs assessment. If the committee determines that there is a need for the product, a full evaluation is implemented.

A critical part of this evaluation is a review of the crash testing of the product. The manufacturer or vendor generally contracts with a testing firm to conduct crash testing of the hardware in accordance with NCHRP Report 350. This testing is intended to demonstrate that the product meets the applicable NCHRP Report 350 criteria. The

METS Roadside Safety Features Branch performs an analysis of the crash testing and presents the results to the full committee. The committee also considers factors such as siting constraints, constructability, appearance and the cost and difficulty of maintenance. Finally, the product must have been accepted by FHWA for use on the National Highway System.

If the HSFNPC concludes that the product meets the applicable NCHRP Report 350 criteria and that the overall review is satisfactory, the committee recommends that the product be approved. The committee chair then prepares an approval letter for signature by the Chief, Traffic Operations Program. Once signed, the letter is sent to the vendor or manufacturer, notifying them of the approval. Copies of the letter are distributed to the districts.

When a new roadside safety product receives approval, that approval is generally experimental. The experimental designation requires that permission be granted prior to use of the product and that an approved construction-evaluated work plan be prepared. Newly approved products retain their experimental status for one to four years, depending on the number of times they are impacted by errant vehicles. This gives the Department the opportunity to assess the performance of the devices in the field. If this performance is acceptable, the product is granted operational approval status and may be used whenever appropriate.

Questions regarding the use of experimental roadside safety features may be directed to Ellis Hirst in the Traffic Operations Program at (916) 654-2465 or Calnet 464-2465.

Work Zone Traffic Control Devices

Although roadside safety hardware does not normally encompass work zone traffic control devices, NCHRP Report 350 covers these devices and FHWA has also established implementation dates for them. Work zone Category I devices consist of plastic cones, drums and tubes. Category I devices purchased on or after October 1, 1998 must meet Report 350 criteria. Category II devices include portable sign stands (with signs) and type 1,2 and 3 barricades (with and without lights) under 45 kg. The implementation date for these is October 1, 2000. Devices similar to Category II but which have a mass greater than 45 kg are classified as Category III and must meet Report 350 criteria by October 1, 2002.

The Traffic Operations Program is still developing a strategy for meeting FHWA's compliance schedule for work zone traffic control devices. For further information, please contact Don Howe of Traffic Operations at (916) 654-2634 or Calnet 464-2634.



HSFNPC Recommends Approval of New Products

Within the past few months, the HSFNPC has recommended that several new products be approved. Some examples include:

Pole-Safe Couplings - An alternative to Caltrans' standard slip base design used on light poles and standards, these couplings consist of necked-down bolts which secure the base plate of the light pole to in-ground anchors. When the pole is struck by a vehicle, the bolts shear at the necks, allowing the pole or light standard to break away (approval pending - experimental).

Improved SRT-350 - To reduce cost and facilitate construction, the manufacturer of this widely used terminal has recently modified it. Among the most significant changes are the reduction in the number of posts from nine to eight and the substitution of different soil foundation tubes for the first two posts. The modifications have operational approval.

QuadTrend - This is an updated version of the old Trend and Sentre devices, which were approved by Caltrans more than a decade ago. The QuadTrend may function either as a terminal or a transition element to a rigid longitudinal barrier (approval pending, experimental).

QuadGuard Elite - The Elite is another member of the QuadGuard family of crash cushions. Instead of using crushable cartridges for energy absorption, this model features polyethylene cylinders which self-restore almost to their original shape

after impact (approval pending - experimental).

Mondo Blockout - As an alternative to the conventional wood guardrail blockout, this recycled polyethylene blockout is available in models that fit either steel or wood posts. Though somewhat more expensive than wood, this product will likely prove to be considerably more durable than wood and it can be recycled instead of being placed in a landfill (approval pending - experimental).

ET-2000 Plus - The only difference between the ET-2000 and the ET-2000 Plus is that the Plus features a new impact head with a mass of only 80 kg vs. 125 kg for the original ET-2000. The crash performance of the Plus also appears to be improved with the new head. The Plus model will replace the original version. The ET-2000 Plus will also be available in a lower-speed version called the ET-2000 Plus TL-2. The TL-2 system is suitable only for locations with prevailing speeds of 70 km/h or less. The ET-2000 Plus TL-2 is 7.6 m long, while the ET-2000 Plus has a total length of 11.6 m (approval pending - operational).

Safe-Stop TMA - This truck-mounted attenuator is manufactured by Energy Absorption as a replacement for its older Alpha 100K model. Most TMAs seen in use on the state highway system are lower-speed units designed to withstand impacts only up to speeds of 70 km/h (i.e., the Alpha 70K). The Alpha 100K was designed for 100 km/h impacts but it was somewhat bulky and awkward to maneuver. The Safe-Stop model is more compact than the Alpha 100K (approval pending - operational).

For updates on the approval status of these devices, please contact Ellis Hirst. A list of approved terminals and crash cushions is available on the Web. On the Caltrans home page, click on

"Doing Business With Caltrans", then "Engineering Service Center" and finally "Qualified Products List" (under "Manuals & Guides"). For other questions regarding these or other proprietary products, you may contact either Ellis Hirst or Rich Peter. Rich can be reached at (916) 227-7257 or Calnet 498-7257.

Crash Testing Evaluates Performance of CT Designs

Caltrans regularly develops new roadside safety technology designs, particularly for longitudinal barriers and barrier transitions. Like any other type of roadside safety hardware, these Caltrans designs must be crash tested to determine whether they meet NCHRP Report 350 criteria.

Caltrans began crash testing in 1953 using live drivers, but as testing became more sophisticated and hazardous, the use of live drivers was abandoned and alternative methods of guiding the test vehicle were developed. Currently, test vehicles are rail-guided almost up to the point of impact to help ensure that the impact on the test article is precisely where it is intended to be. Most test vehicles are self-propelled, although some are towed.

On-board instruments measure acceleration and rotation data along all three axes of a test vehicle and a data acquisition system mounted in the vehicle stores the information until it is downloaded and analyzed after the test. High-speed cameras record the test from several angles and the impact speed is carefully measured. Based on this and other relevant information, staff

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Crash Testing Evaluates Performance of CT Designs

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determine whether the test article complies with the applicable NCHRP Report 350 criteria.

All Caltrans crash testing is conducted at the Caltrans Dynamic Test Facility at the California Highway Patrol Academy in West Sacramento. This facility has ample room for most types of test vehicles to accelerate to the required impact speeds and to accommodate several test articles simultaneously.



820-kg Sedan Impacting Type 732 Bridge Rail

Within the past three years, crash testing has been conducted on the Type 60 median barrier, the Type 732 (single-slope face) bridge rail, the Types 80 and 80SW see-through concrete bridge rails and the long-term temporary barrier (Type K). This testing has revealed several interesting problems associated either with the test articles or the test vehicles that required correction. For example, the opening in the Type 80-series rails was originally 310-mm (12 in) high. When testing the rail with an 820-kg subcompact sedan it was noted that the wheel rims on the sedan, which were only 310 mm in diameter,

managed to penetrate the rail opening and snag on the vertical supports. This problem was resolved by reducing the rail opening to only 280-mm high.

In another instance, a heavy-duty 3/4-ton pickup truck was used as a test vehicle on the Type 732 bridge rail. This truck featured large rear wheel hubs that projected out beyond the tire sidewall. When this hub struck the bridge rail, the axle slid back along the rear leaf spring to which it was attached and the driveshaft was consequently pulled out of the transmission. When the leading end of the driveshaft fell to the ground, the entire truck "pole-vaulted" on the driveshaft and the truck rolled over multiple times. When the test was re-conducted with a second truck featuring conventional hubs, this truck remained stable and the test was successful.



8000-kg Truck Impacting Type 732 Bridge Rail

The Roadside Safety Technology Branch also provides assistance to the Caltrans Legal Program. Legal often asks the branch for help in replicating accident scenarios in tort liability cases. This replication often serves to disprove contentions of the plaintiff's attorneys that Caltrans is responsible for an accident or injury because of something it allegedly did or didn't do. In *Shoemaker vs. the State of California*, a crash test disproved the plaintiff's claim that the presence of a guardrail would have prevented a run-off-the-road

accident. In this test, a Ford Bronco similar to one driven by the plaintiff readily vaulted a standard guardrail under the same impact conditions in the actual accident.



Rollover During Unsuccessful Bridge Rail Transition Test

Ongoing research projects include the development and testing of a single-slope temporary barrier (Type 60K), a guardrail to bridge rail transition section and a steel version of the Type 732 bridge rail that will be used on the new eastern suspension span of the S.F.-Oakland Bay Bridge. Possible future projects include testing of textured concrete barrier and the effect of sound walls mounted on top of concrete barriers on the crash performance of the barriers.

Caltrans also works in cooperation with other states to develop roadside safety hardware improvements. The State of Idaho was looking for an alternative to their pre-cast concrete barrier design that did not meet NCHRP Report 350 criteria. After obtaining design details from Caltrans for our Type K barrier, Idaho DOT crash tested the Type K design (unsecured to the ground) and demonstrated that it complied with Report 350. Consequently, Caltrans will not have to test this barrier prior to FHWA's October 1, 2002 deadline.